

- Announcements
- Lab Quiz
- Pre-lab Lecture
 - ❖ Review M13 engineering
 - ❖ Review solar cell big picture
 - ❖ Intro to TEM
 - ❖ Nanocomposite synthesis/
today in lab (M3D2)

Announcements

- Clarification: penalty-free late day does *not* reflect quality of what Shannon is reading, which is great! 😊
 - good for visit before revision or even before draft
 - applies to BE Writing Lab, Leslie, or MIT Writing Center
- Culminating team assignment for 20.109 [20%]
 - novel research proposal (*not* your UROP work) oral
 - define specific question and approach to address it
 - downtime in lab during M3 to work on it
- Module 3 mini-report [5%]
 - also done as a team, w/4 dedicated lab hours
 - no methods, narrow intro, results & discussion emphasis

Phage display review

first random, then semi-rational approach

always at p0 terminus

transcription

mutagenesis
degenerate primers

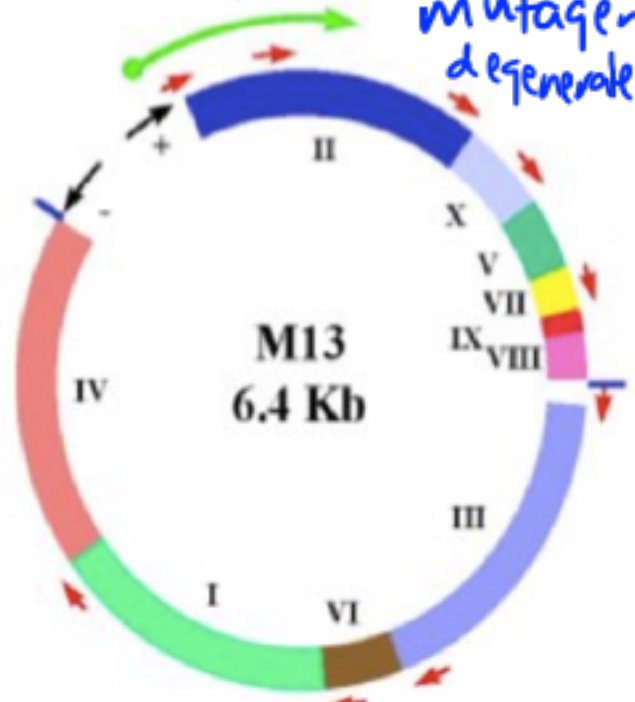


Image from 20.109 wiki

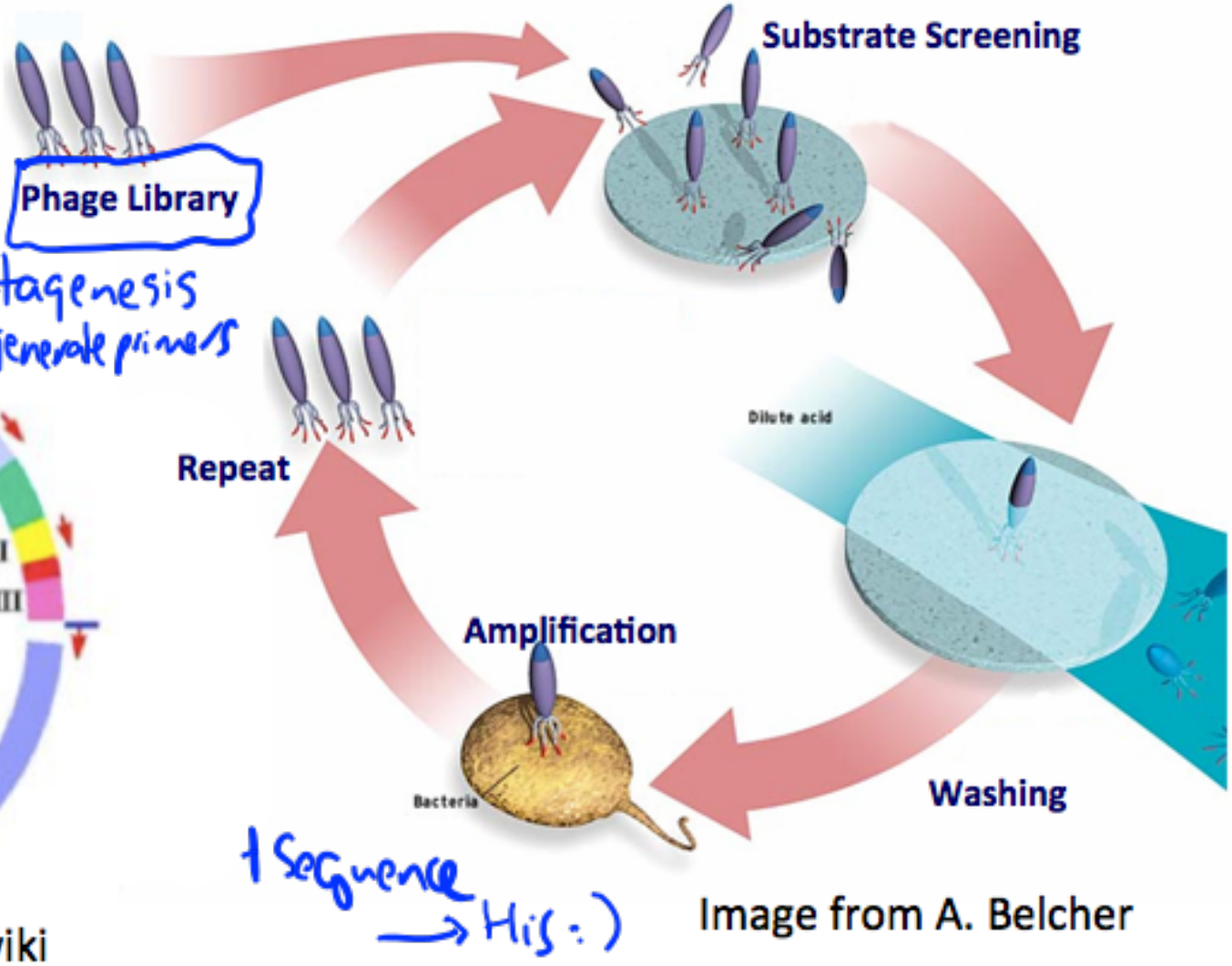



Image from A. Belcher

M13 engineering design choices

- Brainstorm: pros/cons of p3 vs p8 engineering

^{p3}
+ directional 
- few copies (~5)

+ longer, more varied AA sequences

^{p8}
+ mixed population
+ many copies (~2100)

- shorter, less varied & stability

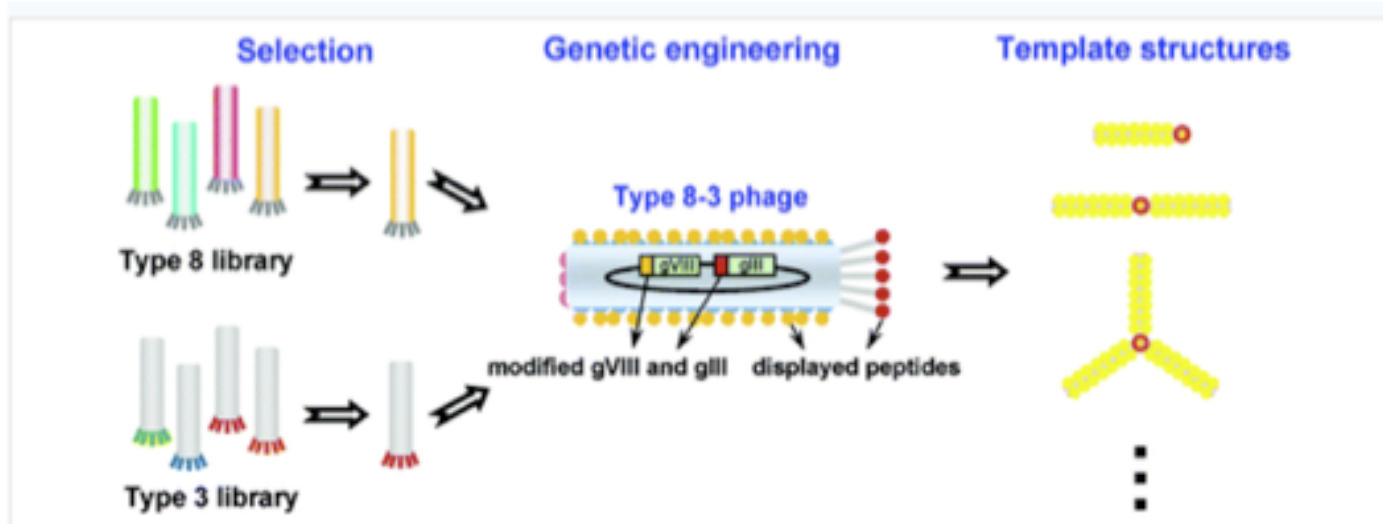
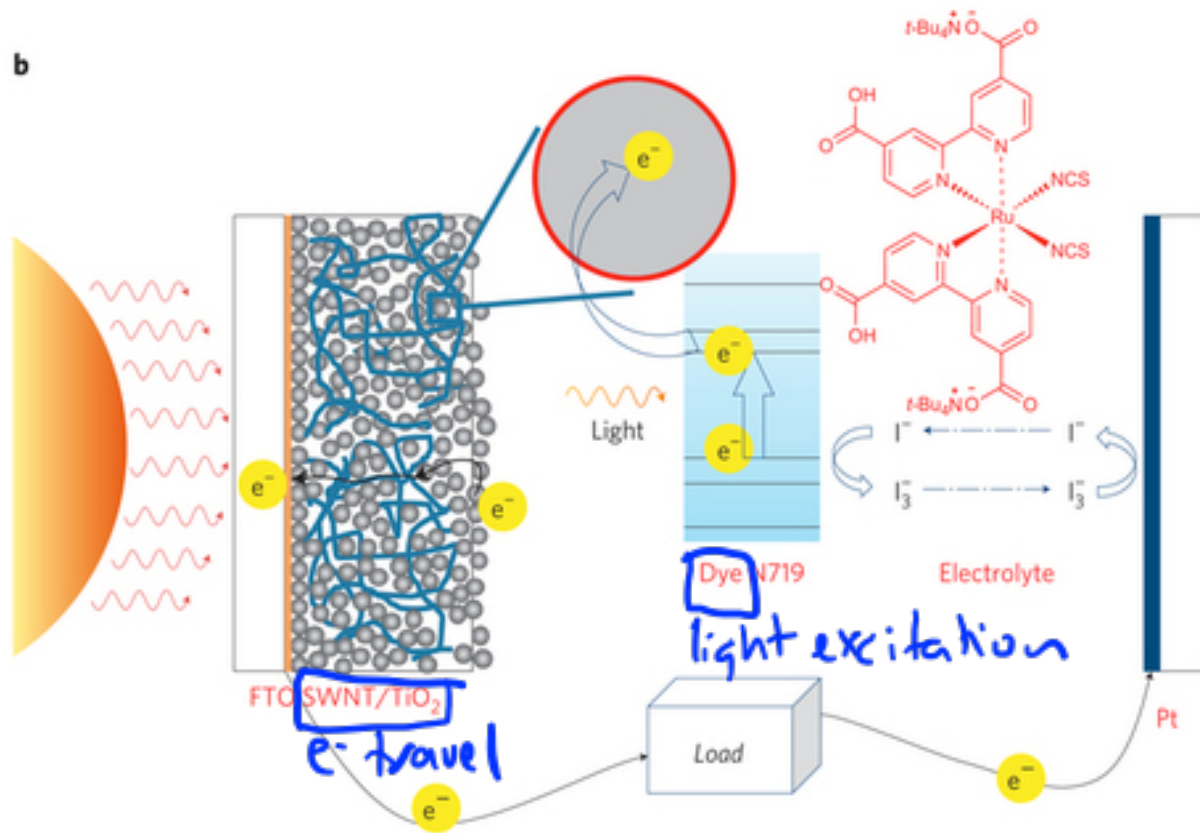


Image from
Y. Huang et
al., *Nano
letters* 5(7):
1429 (2005).

Solar cell review



SWNTs: improve e- paths to detector, collection efficiency
Au: improve *light* collection efficiency, plasmonic effect

Image from wiki

TEM: foundations

- Very high resolution – why?
low λ of e^- compared to light

1-2 Å

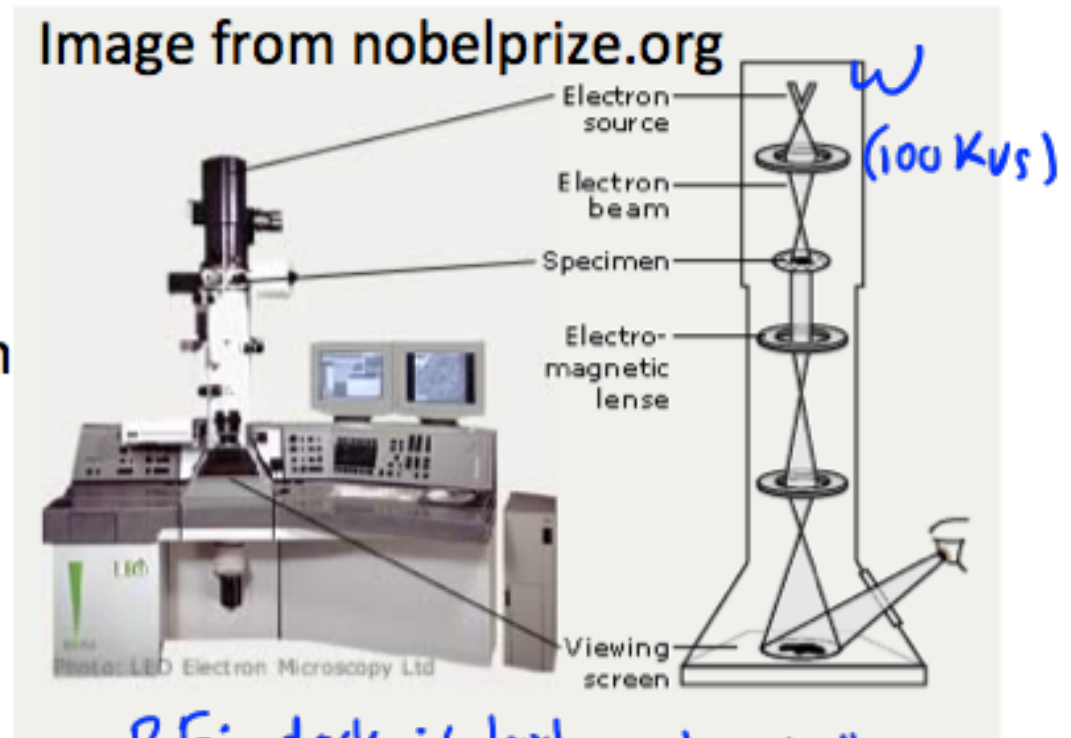
transmitted or scattered

- EM lens to focus
- Sample preparation
 - very thin, under vacuum
 - can't image *in situ* bio.

Cryo-TEM

→ more from Angie on D3

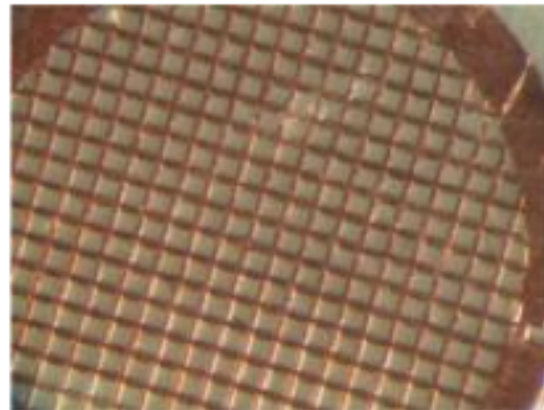
- Many imaging modes



TEM: your experiment

- Morphology, density, *maybe* elemental analysis
- Protocol:
 - Each person should prepare a grid
 - Disperse wires: vortex
 - Load onto Cu/carbon grid
 - Incubate, wash grid

Grid is extremely delicate!



Nanocomposite synthesis: overview

- **Goal:** compare systems made w/varying SWNT/Au: ϕ
- All reacted with same $[\text{Ti}(\text{I-pro})_4]$
- ★ Calculations!

solvent goal: 95% EtOH - based on $V\phi$
solute goal: 15:1 $\text{TiO}_2:\phi$ by *mass*

Prepare supercooled EG/EtOH bath (-40 °C)

Pre-chill EtOH solvent (10')

Add $\text{Ti}(\text{I-pro})_4$ (stir 5')

Add complexed ϕ mixture (stir 20', 1h to RT)

Prepare aliquot for TEM

Centrifuge, wash rest of mixture



toxic by inhalation! in hood conts/glasses/gloves

And... your toddler inspiration!



Fantasia on 'H'

stuff takes practice

practice can be fun